Mathematical model of suspension seat-person exposed to vertical vibration for off-road vehicles

ABSTRACT

Off-road drivers are exposed to a high magnitude of vibration at low frequency (0.5-25Hz), that can cause harm and possibly attribute to musculoskeletal disorder, particularly low-back pain. The suspension seat is commonly used on an off-road condition to isolate the vibration transmitted to the human body. Nevertheless, the suspension seat modelling that incorporates the human body is still scarce. The objective of this study is to develop a mathematical modelling to represent the suspension seat-person for off-road vehicles. This paper presents a three degrees-of-freedom lumped parameter model. A curve-fitting method is used for parameter identification, which includes the constraint variable function (fmincon()) from the optimisation toolbox of MATLAB(R2017a). The model parameters are optimised using experimentally measured of suspension seat transmissibility. It was found that the model provides a reasonable fit to the measured suspension seat transmissibility at the first peak of resonance frequency, around 2-3 Hz. The results of the study suggested that the human body forms a coupled system with the suspension seat and thus affects the overall performance of the suspension system. As a conclusion, the influence of the human body should not be ignored in the modelling, and a three-degrees degree-of-freedom lumped parameter model provides a better prediction of suspension seat transmissibility. This proposed model is recommended to predict vibration transmissibility for off-road suspension seat.

Keyword: Seat-person suspension model; Lumped parameter model; Suspension seat; Transmissibility; Vibration isolation system